

**Area Navigation (RNAV)/Wide Area Augmentation
System (WAAS) Instrument Approach Procedures (IAP's)
and the New Charting Format.
[REVISED 1/28/00]**

PURPOSE.

Instrument procedures in the first half of the 21st century will be based on satellite navigation, also known as Global Navigation Satellite System (GNSS). Within the United States, the Global Positioning System (GPS), the Wide Area Augmentation system (WAAS), and the Local Area Augmentation System (LAAS) will comprise the primary components of the GNSS.

Air navigation is increasingly dependent upon RNAV systems - as exemplified by Flight Management System (FMS) and Global Positioning System (GPS) navigators. These systems navigate with reference to geographic positions called "waypoints" (WP) specified in latitude/longitude rather than to/from a specific ground-based navigation aid. Reliance on RNAV systems for approach and departure operations will increase as new systems such as WAAS are developed and deployed. To foster and support full and optimal integration of RNAV into the National Airspace System (NAS), the FAA has developed a new charting format for RNAV IAP's. This new graphical format maximizes the information available to the pilot for the safe and efficient conduct of the instrument procedure. It presents required information in the clearest and most informative manner possible. This Notice serves to inform the flying public of the new concepts being implemented with the RNAV IAP's.

OPERATIONS.

In order to avoid unnecessary duplication and proliferation of instrument approach charts, the FAA will publish approach minimums for unaugmented GPS and WAAS (when operational) on the same chart. In addition, approach minimums will be established and published for LNAV/VNAV - a new type of RNAV instrument approach with lateral and vertical navigation. The approach chart will be titled "RNAV RWY XX." The chart may contain as many as four lines of approach minimums: GLS; LNAV/VNAV; LNAV; and CIRCLING. Appropriately equipped aircraft may fly to the various published minimums described in paragraphs a through c below:

a. GLS. "GLS" is the acronym for GNSS Landing System; GNSS is the acronym for Global Navigation Satellite System. The minimums line labeled GLS will accommodate aircraft equipped with precision approach capable WAAS receivers operating to their fullest capability. WAAS, as its name implies, augments the basic GPS satellite constellation with additional ground stations and enhanced position/integrity information transmitted from geostationary satellites. This capability of augmentation enhances both the accuracy and integrity of basic GPS, and may support precision (GLS) approach minimums as low as 200' height above touchdown (HAT) and 1/2 statute

mile (SM) visibility. Publication of the lowest GLS minimums require that certain interrelated conditions of satellite availability and runway landing environment are met. The suitability of the landing environment to support the lowest landing minimums is determined by the degree of airport compliance with AC 150/5300-13, Airport Design. Precision runway and airport compliance factors include runway marking and lighting, obstacle clearance surfaces, runway length, approach lighting, taxiway layout, etc. Pilots will be informed that all the requirements of the precision runway landing environment are satisfied by the notation "GLS PA" on the first line of minimums in U.S. Government Terminal Procedure Publication charts. Pilots will be informed that not all of the precision runway requirements are met by the notation "GLS" without the letters "PA" on the first line of minimums. In this latter case, the airborne WAAS receiver may be operating in the most capable mode, but since the landing environment does not support the low visibility operations, minimums no lower than 300' HAT and 3/4 SM visibility will be published. Since computed glidepath guidance is provided to the pilot, procedure minimum altitude will be published as a Decision Altitude (DA).

b. LNAV/VNAV. Since LNAV/VNAV systems provide vertical guidance, the procedure minimum altitude will be published as a DA. The line of minimums labeled as LNAV/VNAV may be used by the following systems:

(1) Precision approach capable WAAS equipment that has reverted to a less capable mode of operation. Conditions such as poor GPS satellite geometry or atmospheric interference may cause precision this reversion. Lateral and vertical navigation are still available to support an instrument approach but to a lesser degree of accuracy. If alerted to this condition by the on-board WAAS equipment, the pilot/crew shall use the LNAV/VNAV minimums.

(2) WAAS lateral-only receiver integrated with an IFR approach approved Barometric (BARO) VNAV system.

(3) RNP-0.3 approved aircraft with an IFR approach approved BARO-VNAV system.

(4) Aircraft equipped with other IFR RNAV systems such as FMS and BARO-VNAV **are required to obtain special approval to** use LNAV/VNAV minimums. See paragraph d below.

c. LNAV. These minimums are for LNAV-only. Because vertical guidance is not provided, the procedure minimum altitude will be published as a minimum descent altitude (MDA). LNAV minimums support the equipment described below:

(1) If the quality of the WAAS navigation solution will not support vertical navigation at all, the WAAS receiver will revert to an LNAV mode. Again, the pilot/crew will be alerted to the loss of VNAV and shall revert to LNAV minimums.

(2) WAAS equipment approved only for nonprecision approaches.

(3) RNP-0.3 approved aircraft.

(4) Navigation systems using basic unaugmented GPS approved for approach operations in accordance with:

(a) AC 20-138, Airworthiness Approval of Global Positioning System (GPS) Navigation Equipment for Use as a VFR and IFR Supplemental Navigation system, for standalone TSO-C129 Class A(1) systems; or

(b) AC 20-130A, Airworthiness Approval of Navigation or Flight Management Systems Integrating Multiple Navigation Sensors, for GPS as part of a multi-sensor system, qualify for these minimums.

d. Other Systems. Through a special authorization, aircraft equipped with other IFR approach approved RNAV systems may fly to the LNAV/VNAV and/or LNAV minimums described above. These systems may include aircraft equipped with an FMS that can file /E or /F. Operational approval must also be obtained for BARO-VNAV systems to operate to the LNAV/VNAV minimums. BARO-VNAV may not be authorized on some approaches due to other factors. Pilots are directed to their local Flight Standards District Office (FSDO) for additional information.

NOTE: RNAV and BARO-VNAV systems must have a manufacturer supplied electronic data base which shall include the waypoints, altitudes, and vertical data for the procedure to be flown. The system shall also be able to extract the procedure in its entirety, not just as a series of waypoints.

REQUIRED NAVIGATION PERFORMANCE (RNP).

With the widespread deployment of RNAV systems, the advent of GPS, and the imminent implementation of WAAS, greater flexibility in route, procedure, and airspace design is now possible, with an associated increase in navigation accuracy and flight safety. To capitalize on the potential of RNAV systems, the FAA and the International Civil Aviation Organization (ICAO) are effecting a shift toward a new standard of navigation and airspace management called RNP.

Navigation systems have typically been described as being sensor specific, such as VOR, NDB, and ILS systems. When RNP is specified, it does not matter what the underlying navigation system or combination of systems is used, provided the aircraft can achieve the required navigation performance. Typically, various sensor inputs are processed by the RNAV system to arrive at a position estimate having a high statistical degree of accuracy and confidence. RNP is intended to provide a single performance standard that can be used and applied to aircraft and aircraft equipment manufacturers, airspace, planners, aircraft certification and operations, pilots and controllers, and international aviation authorities. RNP can be related to obstacle clearance or aircraft separation requirements to ensure a consistent level of application.

An RNP level or type is applicable to a selected airspace, route, or procedure. The applicable RNP is expressed as a value that represents a distance in nautical miles from the intended position to the actual position of an aircraft. It is within this distance that an aircraft would normally be expected to operate. For general RNAV approach procedures, RNP-0.3 is required.

Pilots are advised to refer to the "TERMS/LANDING MINIMUMS DATA" (Section A) of the U.S. Government Terminal Procedures books for aircraft approach eligibility requirements by specific RNP level requirements. Aircraft meeting RNP criteria will have an appropriate entry, including special conditions and limitations, if any, in the Aircraft Flight Manual (AFM) or its supplement. This will only occur when it has been determined that the aircraft complies with the appropriate provisions of certification.

Some aircraft have RNP approval in their AFM without a GPS sensor. The lowest level of sensors that the FAA will support for RNP service is DME/DME. However, necessary DME NAVAID ground infrastructure may or may not be available at the airport of intended operations. For those locations having an RNAV chart published with LNAV/VNAV minimums, a procedure note may be provided such as "DME/DME RNP-0.3 NA"; this means that RNP aircraft dependent on DME/DME to achieve RNP-0.3 are not authorized to conduct this approach. Where FAA flight inspection successfully determines the availability and geometry of DME facilities will support RNP-0.3 and that the DME signal meets inspection tolerances, a note such as "DME/DME RNP-0.3 Authorized" will appear on the chart. And where DME facility availability is a factor, the note may read "DME/DME RNP-0.3 Authorized; ABC and XYZ Required"; meaning that ABC and XYZ facilities have been determined by flight inspection to be required in the navigation solution to assure RNP-0.3.

NEW CHART FEATURES.

The "TERMS/LANDING MINIMUMS DATA" (Section A) of the U. S. Government Terminal Procedures Publication books (reproduced below) provide a detailed explanation of the equipment basis for authorization of certain RNAV equipment suites.

TERMS/LANDING MINIMA DATA

IFR LANDING MINIMA

The United States Standard for Terminal Instrument Procedures (TERPS) is the approved criteria for formulating instrument approach procedures. Landing minima are established for six aircraft approach categories (ABCDE and COPTER). In the absence of Copter minima, helicopters may use Category A minima of other procedures. The standard format for RNAV minima and landing minima portrayal follows:

RNAV MINIMA

CATEGORY	A	B	C	D
GLS PA DA	1382/24 200 (200-½)			
LNAV/ DA VNAV	1500/24 318 (400-½)			1500/40 318 (400-¾)
LNAV MDA	1700/24 518 (600-½)	1700/50 518 (600-1)		1700/60 518 (600-1 ¼)
CIRCLING	1760-1 578 (600-1)	1760 -1½ 578 (600-1½)		1760-2 578 (600-2)

RNAV minimums are dependent on navigation equipment capability, as stated in the applicable AFM or AFMS, and as outlined below.

GLS (Global Navigation Satellite System (GNSS) Landing System)

Must have WAAS (Wide Area Augmentation System) equipment approved for precision approach.

Note: "PA" indicates that the runway environment, i.e., runway markings, runway lights, parallel taxiway, etc., meets precision approach requirements. If the GLS minimums line does not contain "PA", then the runway environment does not support precision requirements.

LNAV/VNAV (Lateral Navigation/Vertical Navigation)

Must have WAAS equipment approved for precision approach, or RNP-0.3 system based on GPS or DME/DME, with an IFR approach approved Baro-VNAV system. Other RNAV approach systems require special approval.

Use of Baro-VNAV systems is limited by temperature, i.e., "Baro-VNAV NA below -20°C(-4°F)". (Not applicable if chart is annotated "Baro-VNAV NA".)

NOTE: DME/DME based RNP-0.3 systems may be used only when a chart note indicates DME/DME availability, for example "DME/DME RNP-0.3 Authorized." Specific DME facilities may be required, for example: "DME/DME RNP-0.3 Authorized. ABC, XYZ required."

LNAV (Lateral Navigation)

Must have IFR approach approved WAAS, GPS, GPS based FMS systems, or RNP-0.3 systems based on GPS or DME/DME. Other RNAV approach systems require special approval.

NOTE: DME/DME based RNP-0.3 systems may be used only when a chart note indicates DME/DME availability, for example "DME/DME RNP-0.3 Authorized." Specific DME facilities may be required, for example: "DME/DME RNP-0.3 Authorized. ABC, XYZ required."

LANDING MINIMA FORMAT

In this example airport elevation is 1179, and runway touchdown zone elevation is 1152.

CATEGORY	A		B		C		D	
	DH		HAT		HAT		HAT	
S-ILS-27	1352/24		200		(200-½)			
S-LOC-27	1440/24		288		(300-½)		1440/50-288 (300-1)	
CIRCLING	1540-1-361 (400-1)		1640-1-461 (500-1)		1640-1½-461 (500-1½)		1740-2-561 (600-2)	
	MDA		HAA		Visibility in Statute Miles			

Straight-in ILS to Runway 27
 Straight-in with Glide Slope Inoperative or not used to Runway 27
 All minimums in parentheses not applicable to Civil Pilots. Military Pilots refer to appropriate regulations.

TERMS/LANDING MINIMA DATA

New features appearing on RNAV instrument approach charts include: procedure name; chart terminology; minimums format; descent angle; threshold crossing height (TCH); chart symbology; terminal arrival areas (TAA); and the pilot briefing information format. These new features will be explained with reference to accompanying chart excerpt graphics.

PROCEDURE NAME.

After a transition period, unaugmented GPS IAP's currently titled "GPS RWY XX" will be converted to the new RNAV plate and titled "**RNAV RWY XX**." Where multiple RNAV procedures exist to the same runway, subsequent RNAV procedure titles will be "**RNAV Z RWY 22**," "**RNAV Y RWY 22**," etc. Pilot/controller communications should utilize phonetic phraseology; e.g., "RNAV ZULU Runway 22," "RNAV YANKEE Runway 22," etc. ATC clearance for the RNAV procedure will authorize the pilot to utilize any landing minimums for which the aircraft is capable, or the pilot and aircraft have been authorized. RNAV procedures, which incorporate a final approach stepdown, fix will be published as separate approach procedures. During the interim period when GPS procedures are undergoing revision to the new title, both "RNAV" and "GPS" approach charts will be published by the National Ocean Service (NOS).

RNAV RWY 22



CHART TERMINOLOGY.

a. **DA** is the acronym for "Decision Altitude." It replaces the familiar term "DH" which is the acronym for "Decision Height" - even though DH was charted as an altitude *above MSL*. Therefore, the U.S. has adopted the term "**DA**" as a step toward harmonization of the United States and international terminology. At some point, DA will be published for all future instrument approach procedures with vertical guidance.

b. **MDA**, the acronym for "minimum descent altitude," has been in use for many years, and will continue to be used for the LNAV and circling procedures.

c. **GLS** identifies minimums developed to accommodate aircraft equipped with augmented GPS equipment.

d. **LNAV/VNAV** identifies minimums developed to accommodate an RNAV IAP with vertical guidance. **LNAV** is the acronym for lateral navigation, **VNAV** for vertical navigation. Aircraft using LNAV/VNAV minimums will descend to landing via an internally generated descent path based on satellite or other approved VNAV systems.

MINIMUMS FORMAT.

a. Each line of minimums on the RNAV IAP will be titled to reflect the associated RNAV system applicable; e.g., **GLS**, **LNAV/VNAV**, and **LNAV**. **CIRCLING** minimums will also be provided when authorized.

b. The minimums title box will also indicate the nature of the minimum altitude for the IAP. For example:

(1) **DA** will be published where the minimums line reflects vertical guidance such as for GLS or LNAV/VNAV.

CATEGORY		A
GLS PA	DA	
LNAV/VNAV	DA	
LNAV...		

NOTE: **DA** indicates to the pilot that the published descent profile is flown to the Decision Altitude, where a missed approach will be initiated if visual references for landing are not established. Obstacle clearance has been provided to allow a momentary descent below DA while transitioning from the final approach segment to the missed approach.

(2) **MDA** will be published where the minimums line reflects only lateral guidance. Descent below the MDA is not authorized unless the visual conditions stated in 14 CFR Part 91.175 exist.

CATEGORY		A
GLS...		
LNAV/VNAV...		
LNAV	MDA	

DESCENT ANGLE.

a. It is **FAA policy to design IAP's** with minimum altitudes established at fixes/waypoints to achieve optimum stabilized (constant rate) descents within each procedure segment. This design can enhance the safety of the operations and contribute toward reduction in the occurrence of controlled flight into terrain (CFIT) accidents. Additionally, the National Transportation Safety Board (NTSB) recently emphasized that pilots could benefit from publication of the appropriate IAP descent angle for a stabilized descent on final approach. The new RNAV IAP format will, therefore, include the descent angle to the hundredth of a degree; e.g., **3.00°**. The angle will be provided in the graphically depicted descent profile.

b. The **stabilized approach** may be performed by reference to vertical navigation information provided by WAAS or LNAV/VNAV systems; or for LNAV-only systems, by

the pilot determining the appropriate aircraft attitude/ground speed combination to attain a constant rate descent which best emulates the published angle. To aid the pilot, U. S. Government Terminal Procedures Publication charts publish an expanded Rate of Descent Table on the inside of the back hard cover for use in planning and executing precision descents under known or approximate ground speed conditions.

TCH.

a. Most pilots are aware of this acronym for “Threshold Crossing It is a term traditionally used in “precision” approaches as the height of the glide slope above threshold. Now, with publication of LNAV/VNAV minimums and RNAV descent angles, including graphically depicted descent profiles, TCH will also apply to the height of the “descent angle,” or glidepath, where it crosses above the threshold.

b. Unless otherwise required for larger type aircraft, which may be using the IAP, the typical TCH will be 30-50 feet.

CHART SYMBOLOGY.

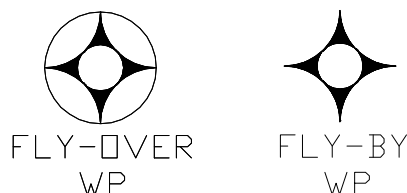
a. Descent Profile. The published descent profile and a graphical depiction of the vertical path to the runway will be shown. Graphical depiction of an RNAV descent angle will differ from the traditional depiction of an ILS glide slope (feather) through the use of a simple vertical track.

b. Visual Descent Point (VDP). A VDP will be published on most RNAV IAP's. When published, VDP's will pertain only to aircraft utilizing LNAV minimums - not GLS or LNAV/VNAV. An attention symbol (*) will be affixed to the VDP depiction on the profile view, with an accompanying procedure note “ * **LNAV only** ” usually located in the profile view.

c. Missed Approach Symbolology. In order to make missed approach guidance more readily understood, a method has been developed to display missed approach guidance in the profile view through the use of icons. Due to limited space in the profile area, only four or fewer icons will be shown. These icons are easily and rapidly understandable, leaving little room for pilot confusion. However, they may or may not provide representation of the entire missed approach procedure. The entire set of textual missed approach instructions is provided at the top of the approach plate in the “pilot briefing.” Refer to the example RNAV plate provided later in this Notice.

d. Waypoints. Most pilots are familiar with the waypoint (WP) symbol. Symbolology introduced on new RNAV IAP's is intended to inform the pilot of the distinction between a “fly-over (FO) WP” and a “fly-by (FB) WP.” As depicted on the planview of the approach procedure: the “fly-by WP” will use the standard WP symbol. However, the “fly-over WP” will enclose the WP symbol inside a circle. If flown manually, pilots should anticipate the turn at a FB WP to ensure a smooth transition from one segment to the next. Alternatively, for a FO WP, no turn is accomplished until the aircraft passes the

WP. All RNAV or GPS stand-alone IAP's are flown using data pertaining to the particular IAP obtained from an onboard database, including the sequence of all WP's used for the approach and missed approach. Included in the database is coding that informs the navigation system of which WP's are FB or FO. The navigation system may provide guidance appropriately - including leading the turn prior to a FB WP; or causing overflight of a FO WP. Chart symbology for the FB WP will provide pilot awareness of expected actions.



TERMINAL ARRIVAL AREAS (TAA).

TAA's are currently described in the Aeronautical Information Manual (AIM) in Chapter 1 under GPS. When published, the new RNAV plate will depict the TAA areas through the use of "icons" representing each TAA area associated with the RNAV procedure. These icons will be depicted in the planview of the approach plate, generally arranged on the plate in accordance with their position relative to the aircraft's arrival from the en route structure. The WP, to which navigation is appropriate and expected within each specific TAA area, will be named and depicted on the associated TAA icon. Each depicted named WP is the IAF for arrivals from within that area. TAA's may not be depicted on all RNAV procedures because of the inability for ATC to accommodate the TAA due to airspace congestion.

PILOT BRIEFING.

A new feature sure to catch your eye is the information provided at the top of the chart. This data is referred to as a "pilot briefing," and there are three rows of information presented. The information condenses, into one location, pertinent information the pilot needs to conduct the approach, and/or brief to other aircrew members. Included are the final approach course, runway/airport data, procedure restrictions, approach light data, missed approach text, WAAS and BARO-VNAV information, and the various ATC and NAVAID frequencies to use.

a. Cold Temperature Limitations. Considering the pronounced effect of non-standard temperature on BARO-VNAV operations, a minimum temperature limitation will be published for each procedure for which BARO-VNAV operations are eligible. This temperature represents the airport temperature below which use of the BARO-VNAV will not be authorized to the LNAV/VNAV minimums. An example limitation will read: "**BARO-VNAV NA below -20°C(-4°F).**" This information will be found in the upper left-hand area of the pilot briefing.

b. WAAS Channel Number/Approach ID. The WAAS Channel Number is an equipment optional capability that allows the use of a 5-digit number to select a specific instrument approach procedure. The Approach ID is a unique 4-letter combination for verifying selection of the correct procedure. The WAAS Channel Number and Approach ID will be displayed prominently in the approach procedure pilot briefing.

c. Approach Procedure Selection. The WAAS Channel Number and Approach ID provide one method available to the pilot for selecting and verifying the approach procedure for the runway of intended landing from the on-board databases. Some equipment may utilize a menu selection method.

(1) The “menu” method. In general, although the steps may vary among equipment types, the pilot first selects the airport of intended landing using the airborne equipment control panel. From a menu that is presented for this airport, the pilot then selects the approach runway. Selecting, from the menu, the Approach ID that matches the Approach ID printed on the approach chart then makes selection of the specific approach procedure. Finally, the pilot activates the procedure by selecting the IAF with which to begin the approach.

(2) 5-Digit Channel Number Method. The pilot enters the unique 5-digit number provided for the approach chart, and the receiver recalls a specific approach procedure from the aircraft data base. A list of information including the “Approach ID” and available IAF’s is displayed. The pilot confirms the correct procedure is selected by comparing the Approach ID listed with that printed on the approach plate. Finally, the pilot activates the procedure by selecting the appropriate IAF with which to begin the approach.

SCHEDULE FOR TRANSITION TO RNAV PROCEDURES.

FAA development of RNAV procedures will be according to the following priority scheme:

- a. Runways not served by an ILS at Title 14 CFR Part 139 airports. Part 139 airports are those supporting scheduled passenger operation of an air carrier using aircraft having a seating capacity of more than 30 passengers.
- b. IFR runways not served by an ILS and greater than or equal to 5,000’ in length.
- c. All other runways.

NEW RNAV PLATE:

